Retrieval of aerosol optical depth and aerosol model over East Asia from directional intensity and polarization measurements

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The advantages of performing aerosol retrieval with multi-angle, multi-spectral photopolarimetric measurements over intensity-only measurements come from the sensitivity to aerosol microphysical properties such as aerosol particle size, shape and complex refraction index. In our previous work, an algorithm based on the assumption of spectral reflectance shape invariance principle was developed using the information of total intensity and polarization supplied by the PARASOL (Polarization and Anisotropy of Reflectances for Atmospheric Science coupled with Observations from a Lidar). In this work the algorithm is applied to one year of PARASOL measurements in 2008 to retrieve aerosol optical properties including the aerosol optical depth (AOD), the aerosol fine-mode fraction (FMF), and the aerosol single scattering albedo (SSA).

Cases studies over east China for different aerosol scenes are carried out to evaluate the performance of the retrieval algorithm. The resulting spatial distributions of AOD over JING-JIN-JI (Beijing–Tianjin–Hebei) metropolitan area in clean, polluted and dust air conditions are compared with MODIS (Moderate-resolution Imaging Spectroradiometer) C6 AOD products. It shows the PARASOL AOD distribution agrees well with MODIS AOD products in the JING-JIN-JI area. PARASOL AOD retrievals and MODIS AOD products show solid correlation with the correlation coefficient value of ~0.8 and ~0.9 for Beijing and the JING-JIN-JI area, respectively.

The retrieved aerosol optical properties from one year of PARASOL measurements in 2008 are evaluated against ground-based measurements at nine AERONET (Aerosol Robotic Network) sites in China. The linear fit slopes of PARASOL and AERONET AOD data sets for nearly all sites are larger than 0.7 except for SACOL and Jingtai where coarse particles dominated. Relatively higher fraction of accurate retrievals in these two sites show higher sensitivity of the algorithm to the coarse particles. The retrieved FMF and AERONET FMF compare reasonably well, with the majority (~83%) of the collocated points within the error range of ±0.3. It indicates the algorithm is sensitive to the aerosol modes. The larger bias in SSA as compared with the optimized algorithm lies in the failure of searching in the continuous aerosol mode space.

References

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